

SUMMARY OF THE INVENTION

[0004] Accordingly, it is an objective of the present invention to create a suction system operating at comparatively low power, allowing adequate filtration of the suction air, and offering automated emptying of the collecting container.

[0005] The present invention provides a collecting container that is fitted with a closing device at its lower side. Opening the closing device allows emptying of the material collected therein, which are caps that were screwed and/or pulled off. Advantageously with respect to simple design and reliable operation, the closing device is in the form of a flap. When such a flap constitutes at least part of the base of the collecting container, a large cross-sectional aperture of the collecting container will have been attained.

[0006] An especially simple and operationally reliable design is attained in that the closing device includes a substantially horizontal pivot shaft and in that a counterweight dimensioned relative to the pivot shaft is provided. The counterweight keeps the closing device closed, or nearly so, even in the absence of a partial vacuum. Preferably, during operation the closing device is directly loaded with caps of sample containers and is kept closed by the partial vacuum. When partial vacuum is eliminated, the sealing system will pivot under the weight of one or more caps into an open position. Emptying of the collecting container is especially well reproducible if the device constitutes a chute in its open position, in particular in the zone of the base wall, the caps then drop by their own weight.

[0007] Advantageously, the blower is a centrifugal blower to provide low power consumption and low noise with good suction resulting in high partial vacuum at small suction cross-sections and, hence, high flows in the suction duct. In particular as regards medical purposes, the apparatus shall be advantageously fitted with a filter which, for a particle size of $0.2 \mu\text{m}$, will filter at a rate of about 95 %. For simplified maintenance, this filter may be a filter cartridge mounted at the blower's suction side.

[0008] With regard to a method to implement the apparatus, advantageously the blower shall be turned off to empty the collecting container, whereupon the closing device weighed down by the caps pivots into the open position. The caps then drop or fall from the closing device, which

thereafter is rotated by the counterweight into a position at least almost closed again. Accordingly, with the present invention emptying can be implemented merely by shutting off the blower. If, following emptying, the blower again is turned on, the closing device is moved on account of the partial vacuum into its closed position. Accordingly, the system of the invention again is operational upon switching on the blower, and the partial vacuum assures that the closing device will be closed.

[0009] A particular advantageous application of the apparatus of the present invention is as part of an automated opening apparatus for human or animal liquid samples.

BRIEF DESCRIPTION OF THE DRAWING

[0010] An embodiment of the present invention is discussed below in relation to the drawing wherein:

[0011] Fig. 1 is a perspective of a suction system according to the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0012] Fig. 1 is a perspective view, as seen obliquely from below, of the suction system of the invention in its installed configuration. As shown in Fig. 1, the suction system of the invention fitted with a suction duct 1 which issues into a collecting container 2. The collecting container 2 supports, at its top side, a filter cartridge 3 and, at its bottom side, a closing flap 4 that simultaneously constitutes the collecting container's base wall. A centrifugal blower 5 is mounted at the top of the filter cartridge 3, and accordingly the already filtered exhaust air is fed to the blower 5.

[0013] The closing flap 4 (shown in its open state in Fig. 1) comprises a flat side 7 able to fully cover a lower aperture 8 of the collecting container 2. The flat side 7 is bounded at two mutually opposite sides by guide elements 9 which run perpendicularly to the flat side 7. Moreover, the closing device 4 comprises a support 10 receiving a pivot shaft 11 mounted in the region of a U-shaped segment 12.

[0014] The U-shaped segment 12 also supports a counterweight 13 situated at the end zone of the U-shaped segment 12, which is away from the flat side 7. The counterweight 13 is displaceably affixed in longitudinal slots 15 by means of tightening screws 14. The pivot shaft 11, in turn, is mounted into extensions 16 of the collecting container 2. As a result, the closing device 4 is pivotally mounted at a given position on the collecting container 2. In practice, the above described suction system may be integrated, for instance, into an automated sample handling apparatus for the purpose of automatically opening blood samples or other sample containers. In this design, the suction duct passes through a tube 20 to a means for taking off the caps. The remaining suction system is mounted such that the filter cartridge 3 shall be installed underneath the base plate of the sample handling apparatus and, moreover, space shall be provided underneath the collecting container 2 to receive a waste receptacle or bag.

[0015] The system described so far operates as follows:

[0016] The counterweight 13 of the closing device 4 is adjusted such that, when the device is at rest, (i.e., when the blower is shut off), and the collecting container 2 is devoid of caps, the flap 4 shall very nearly or entirely close the aperture 8. Thereupon, the blower 5 is activated and generates a partial vacuum in the collecting container 2 and causes the flat side 7 to be drawn against the aperture 8 and reliably retained there. The blower's suction side communicates with the suction duct 1 and the tube 20 which, in turn, issues into means opening the sealing caps (not shown). Because the filtering cartridge 3 is connected to the suction side of the blower 5, the entire aerosol-charged space will be subjected during operation to a partial vacuum and, as a result, any leaks may entail an intake of secondary air, but will not release aerosols. The pressure side of the blower 5 issues into the ambient. A waste receptacle of appropriate size is placed underneath the suction device.

[0017] A sample container cap screwed or pulled off in the vicinity of the tube 20 is thereupon released by the aperture device and aspirated by the airflow into the tube 20. From there, the cap passes through the tangentially connected suction duct 1 and into the collecting container 2 in which, because of the increasing cross-section, the aspirated air slows, and the cap/stopper drops in the direction of gravity onto the flat side 7 of the closing device 4. For the time being, the cap will stay there. In the case of consecutive opening of sample containers, the next arriving cap